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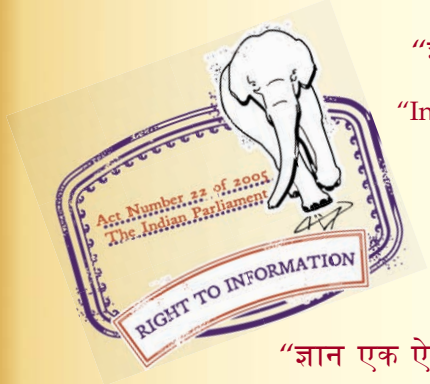
IS 6849-1 (1999): Positive Displacement Vacuum Pumps - Measurement of Performance Characteristics, Part 1: Measurement of Volume Rate of Flow (Pumping Speed) [MED 17: Chemical Engineering Plants and Related Equipment]



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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 6849 (Part 1) : 1999
ISO 1607-1 : 1993
(Reaffirmed 2005)

भारतीय मानक

धनात्मक विस्थापन निर्वात पंप — कार्यकारिता लक्षणों का मापन

भाग 1 प्रवाह (पंपिंग गति) की आयतन दर का मापन

(दूसरा पुनरीक्षण)

Indian Standard

POSITIVE DISPLACEMENT VACUUM PUMPS — MEASUREMENT OF PERFORMANCE CHARACTERISTICS

PART 1 MEASUREMENT OF VOLUME RATE OF FLOW (PUMPING SPEED)

(Second Revision)

ICS 23.160

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 1999

Price Group 2

NATIONAL FOREWORD

This Indian Standard (Second Revision) which is identical with ISO 1607-1 : 1993 'Positive-displacement vacuum pumps — Measurement of performance characteristics — Part 1 : Measurement of volume rate of flow (pumping speed)', issued by the International Organization of Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Chemical Engineering Plants and Related Equipment Sectional Committee (HMD 17) and approval of the Heavy Mechanical Engineering Division Council.

This standard was first issued in 1973 as 'Methods of measurement of the performance characteristics of Positive-displacement vacuum pumps : Part 1 Measurement of the volume rate of flow (pumping speed)'. Consequent upon the publication of ISO 1607-1 : 1980, this standard (including its title) was revised by adopting ISO 1607-1 : 1980, to bring it in alignment with international practices.

The second edition of ISO 1607-1 that is, its first revision was published in 1993. The following changes have been carried out in this revised version:

a) Symbols of volume rate of flow and throughput of the gas have been changed.

b) Ambient air to be used as test gas in place of dry gas.

c) Accuracy of measuring throughput of gas has been related to units $Pa.m^3/s$ in place of W, assuming Ideal Gas behaviour at 20°C.

d) Few dimensions of test dome modified and few dimensions not specified earlier have been specified.

The text of ISO standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

This standard has been issued in several parts. Other parts of this standard are:

IS 6849 (Part 2) : 1993/ISO 1607-2 : 1989 Positive displacement vacuum pumps — Measurement of performance characteristics : Part 2 Measurement of ultimate pressure (*first revision*)

IS 6849 (Part 3) : 1976 Methods of measurement of the performance characteristics of positivedisplacement vaccum pumps : Part 3 Water vapour pumping capacity

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

POSITIVE DISPLACEMENT VACUUM PUMPS — MEASUREMENT OF PERFORMANCE CHARACTERISTICS

PART 1 MEASUREMENT OF VOLUME RATE OF FLOW (PUMPING SPEED)

(Second Revision)

1 Scope

This part of ISO 1607 specifies methods of measuring the volume rate of flow of positive-displacement vacuum pumps.

The pumps considered are those which discharge the gas against atmospheric pressure and which achieve a limiting inlet pressure of less than 100 Pa[1)] in one stage.

These pumps may be with or without baffle(s) or trap(s).

2 Definitions

For the purposes of this part of ISO 1607, the following definitions apply.

2.1 volume rate of flow, pumping speed: Under ideal conditions, the volume of gas which flows in unit time through the pump inlet.

For practical purposes, however, the volume rate of flow (S) of a given pump for a given gas is, by convention, taken to be the quotient of the throughput (Q) of that gas and the equilibrium pressure (p) at a specified position in a given test dome and under specified conditions of operation. Thus

$$S = Q/p$$

The units adopted for the volume rate of flow are the cubic metre per hour (m^3/h) or the litre per second (l/s).

2.2 test dome; test header: A chamber of specific form and dimensions, attached to the inlet of the pump, through which a measured flow of gas may be admitted to the pump, and which is equipped with means of pressure measurement.

2.3 ultimate pressure: Limiting pressure approached asymptotically in the dome, with the gas inlet valve closed and the pump in normal operation.

3 Apparatus

3.1 Test dome, cylindrical and of the form shown in figure 1. The axial dimension of the dome is $1{,}5D$, where D is the internal diameter, and the test gas entrance is on the axis at a distance D from the connecting flange and so arranged that the gas entrance into the dome is in a direction away from the pump mouth. The connection to the gauge for measurements of inlet and ultimate pressures is at a distance $0{,}5D$ from the connecting flange with its axis perpendicular to that of the dome. The axis of the test dome shall be perpendicular to the plane of the inlet flange of the pump.

The volume of the test dome (V_D) shall be at least five times the volume swept by the pump during one compression cycle (V_p). The connection to the inlet of the pump shall consist of an adaptor, the length of which shall not exceed $0{,}5D$ (see figure 1). The appropriate dome dimensions for pumps of given sizes are indicated in table 1.

3.2 Pressure gauge, calibrated to an accuracy of ± 5 % for pressures greater than or equal to 1 Pa and of ± 10 % for lower pressures.

1) 100 Pa = 100 N/m^2 = 1 mbar; 133 Pa = 1 torr

Table 1

V_p litres	V_D litres	D mm
0 to 0,26	1,3	100
0,26 to 1,1	5,4	160
1,1 to 4,2	21	250
4,2 to 17	84	400
17 to 65	325	630
65 to 260	1 300	1 000

3.3 Test gas

Ambient air shall be used unless otherwise specified.

3.4 Gas-throughput measuring device

The method adopted for measuring the throughput of gas will depend on the throughput required. The accuracy shall reach

a) ± 3 % for throughputs greater than $9,9 \times 10^{-1}$ Pa·m^3/s;

b) ± 5 % for throughputs between $9,9 \times 10^{-1}$ Pa·m^3/s and $9,9 \times 10^{-5}$ Pa·m^3/s;

c) ± 10 % for lower throughputs.

NOTE 1 Ideal gas behaviour at 20 °C is assumed.

4 Test method

4.1 Principle

The method adopted is the "constant-pressure" method, in which the pressure at the mouth of the pump is intended to be kept constant during the measuring procedure. In practice, this condition is considered satisfied if the pressure measured in the test dome remains constant.

4.2 Procedure

For measurement of the volume rate of flow, the test dome, pressure-measuring gauge and flowmeter shall be fitted to the pump as indicated in clause 3. For the purpose of the test, the pump shall be run with the prescribed charge and grade of fluid and at the rotational speed specified by the manufacturer. The ambient temperature shall be kept constant within ± 1 °C, for the period of the test, in the range 15 °C to 25 °C unless otherwise specified. The test dome shall be evacuated when isolated from the gas inlet system until, over a period of 1 h, no further pressure drop is observed in the dome and the pump has reached its equilibrium operating temperature. Gas shall then be admitted into the dome in such a manner as to produce the required measurement pressure, and the system shall be allowed to reach a state of pressure equilibrium before measurements are commenced.

The volume rate of flow (pumping speed) shall be measured, starting at the lowest pressure, point-by-point at different inlet pressures (at least three measurements within one power of ten, i.e. at 2,5; 5 and 10 approximately). For each measurement point, the inlet pressure, ambient atmospheric pressure and the throughput of gas shall be determined. In the case of pumps fitted with a gas ballast facility, the test shall be repeated with full gas ballast flow.

Inlet pressure and input flow of gas shall, as far as possible, be measured simultaneously. If the metering of the input gas takes more than 60 s, a pressure measurement shall be taken for each period of 60 s and the mean value recorded. If the highest and lowest readings differ by more than 10 %, the measurement shall be repeated.

5 Test results

The relationship between the inlet pressure and the volume rate of flow shall be shown on a graph using a logarithmic abscissa for pressure, covering the range from the ultimate pressure up to atmospheric pressure, or such other range as may be appropriate to the design of pump, and a linear ordinate for the volume rate of flow. The corresponding relationship between the inlet pressure and the throughput of gas shall be shown on a graph using a logarithmic abscissa for the pressure and a logarithmic ordinate for the throughput. In the case of pumps fitted with a gas ballast facility, these curves shall be derived both without gas ballast and with full gas ballast flow.

6 Test report

The test report shall include the following:

a) type and conditions of operation of all gauges used;

b) type of gasket used on the pump inlet flange;

c) type of any baffle(s) and/or trap(s) employed, and their temperatures during the test;

d) cooling water flowrate;

e) rotational speed of the pump, and limits of variation during the test;

f) rate of gas ballast flow, in m^3/h (or l/s), if applicable;

g) ambient temperature and pressure.

Dimensions in millimetres

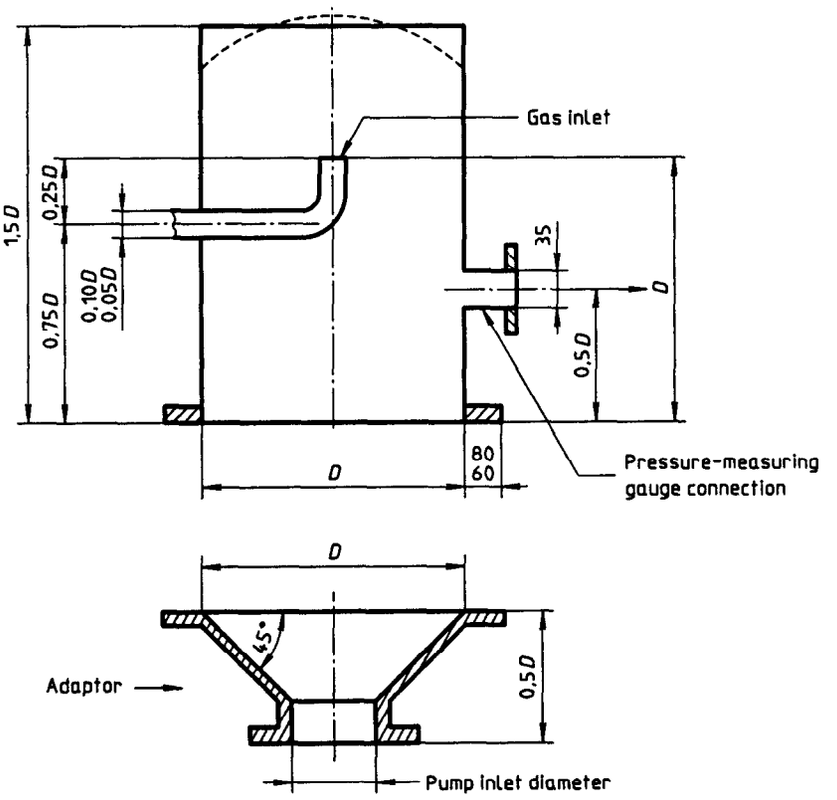

Figure 1 — Test dome

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. HM 17 (0503).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 323 01 31, 323 94 02, 323 33 75

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17 323 38 41
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	337 84 99, 337 85 61 337 86 26, 337 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43 60 20 25
Southern : C. I. T. Campus, IV Cross Road, CHENNAI 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	832 92 95, 832 78 58 832 78 91, 832 78 92

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